Recent Validation Results for the Neural Network V6 First Guess

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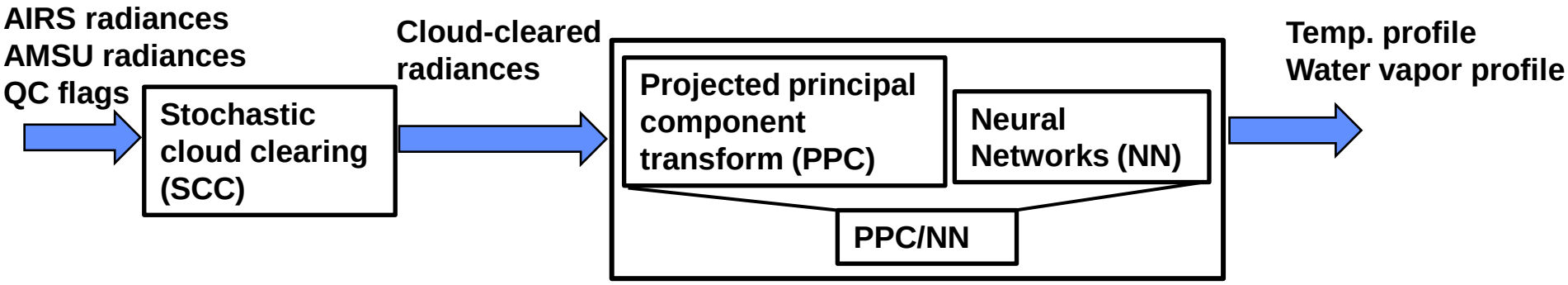
Outline

- SCC/NN Overview
- Validation using ECMWF
  - Golden Days
  - Selected days from 2010
- Validation using Radiosonde
  - Processing
  - Results for 2003, 2004, and 2010
- Conclusion

Overview

- **Stochastic Cloud Clearing / Neural Network (SCC/NN) algorithm provides initialization for V6 of the AIRS L2 physical retrieval**
- **This briefing presents comprehensive validation results over multiple years and datasets**
- **Results will be prepared for future publication**

Stochastic Cloud Clearing / Neural Network (SCC/NN)



- **SCC/NN algorithm is a statistical method for retrieval of temperature and water vapor profiles using AIRS and AMSU**
  - **SCC: Estimates cloud-cleared infrared spectrum using series of linear and nonlinear operations on AIRS/AMSU radiances**
  - **NN: Estimates temperature and water vapor profile from projected principle components of the cloud-cleared spectrum**

SCC/NN Training

- SCC training targets are clear-air radiances generated by SARTA based on ECMWF profiles
- NN training targets are ECMWF temperature and water vapor profiles
- Training data drawn from every 4th day between December 2004 and January 2006
- SCC/NN data divided into ~200 stratifications (based on 5 variables), each with a comprehensive training set
  - Ascending/descending, land/ocean, latitude, surface pressure, and season
  - Each stratification: ~30,000 training profiles, ~5,000 validation profiles, ~5,000 testing profiles

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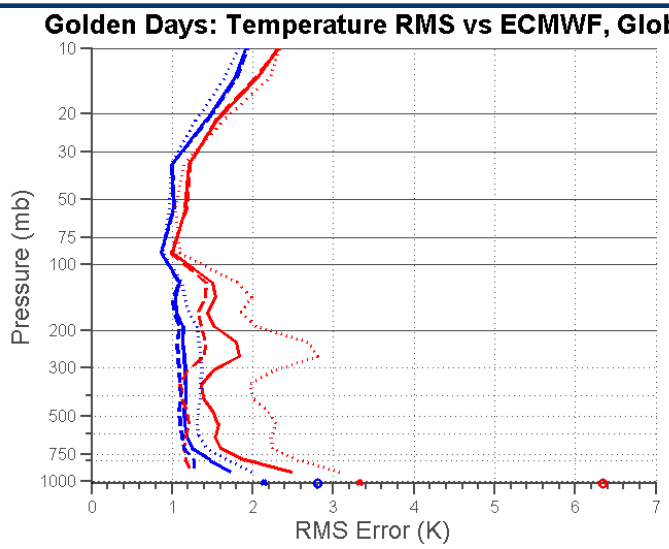
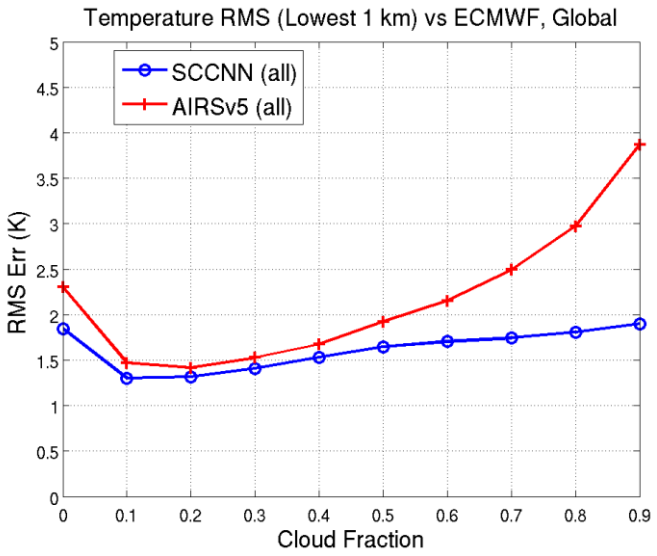
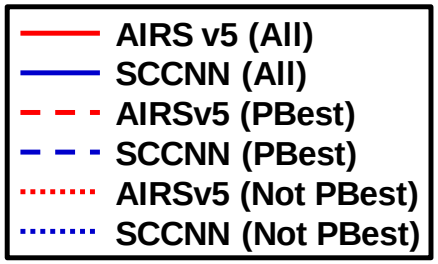
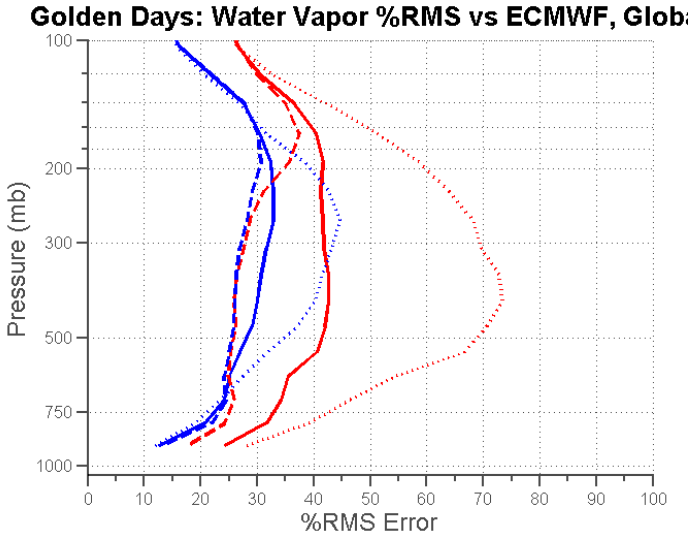
Golden Days RMS Plots: Global RMS vs. ECMWF



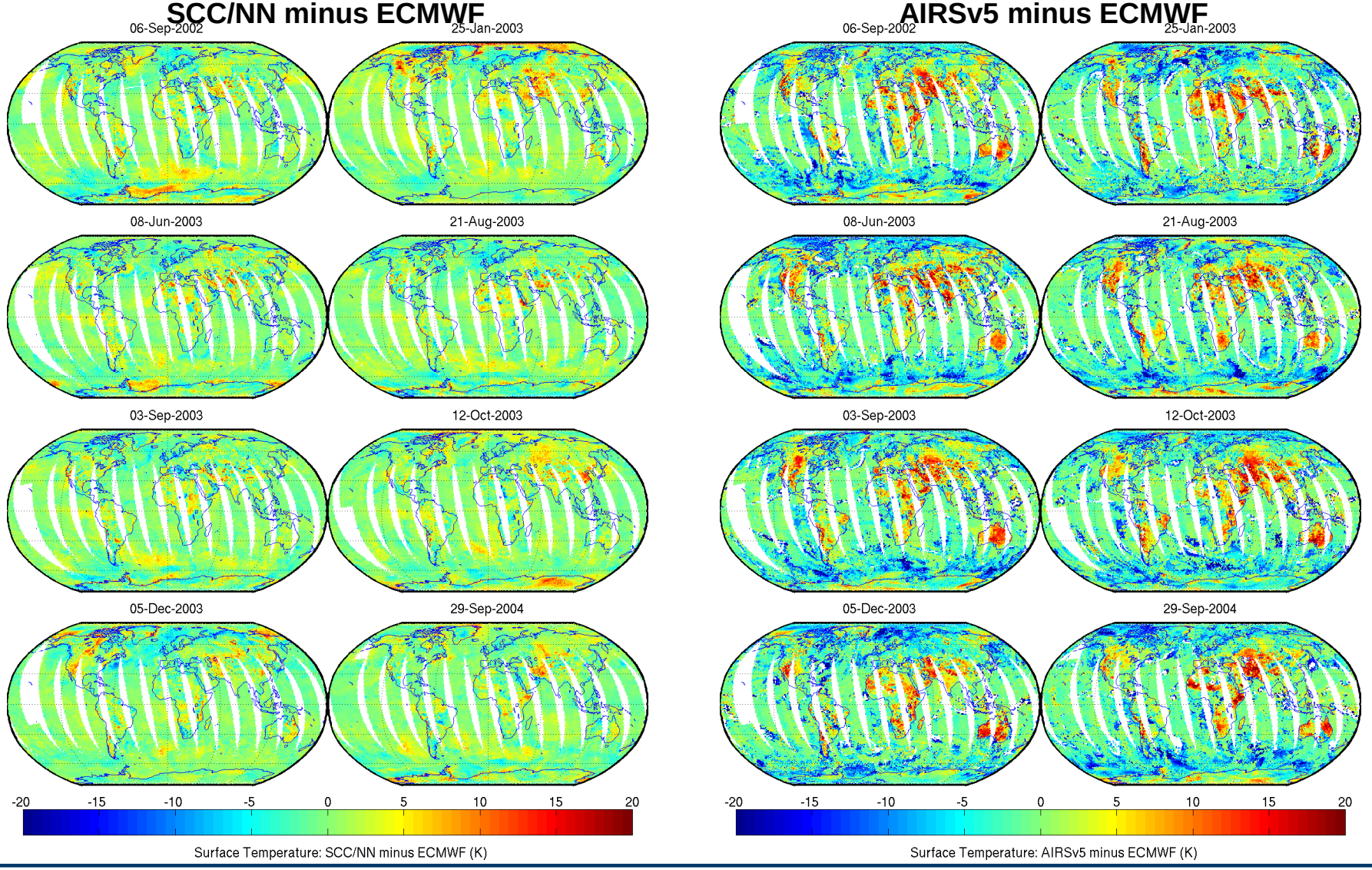




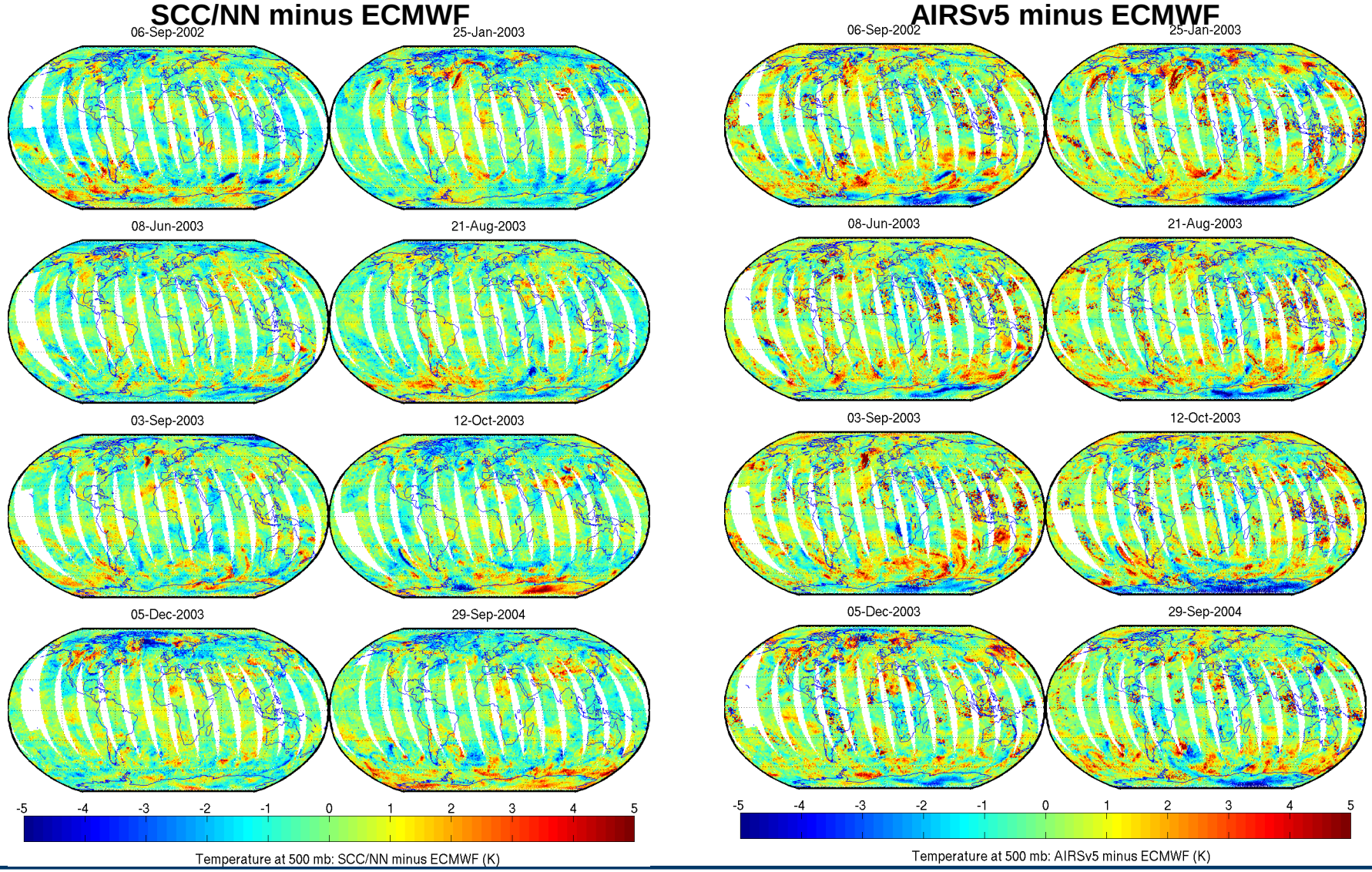


- **RMS difference vs. ECMWF for 8 Golden Days, including 2,592,000 “golf ball” retrievals**
- **Golden Days: 9/6/02, 1/25/03, 6/8/03, 8/21/03, 9/3/03, 10/12/03, 12/5/03, 9/29/04**
- **SCC/NN shows overall improvement in RMS vs. ECMWF and robustness to cloudy scenes**

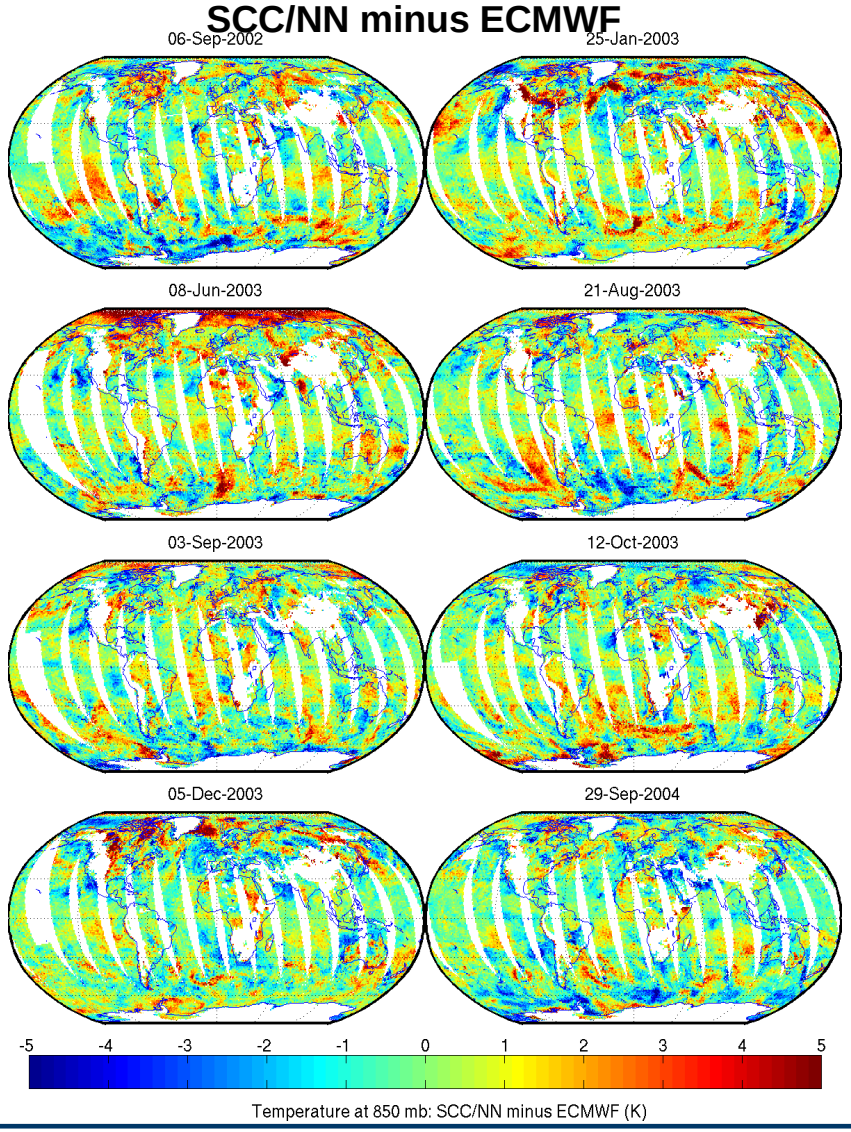
Example Results: Surface Temperature Minus ECMWF, Ascending

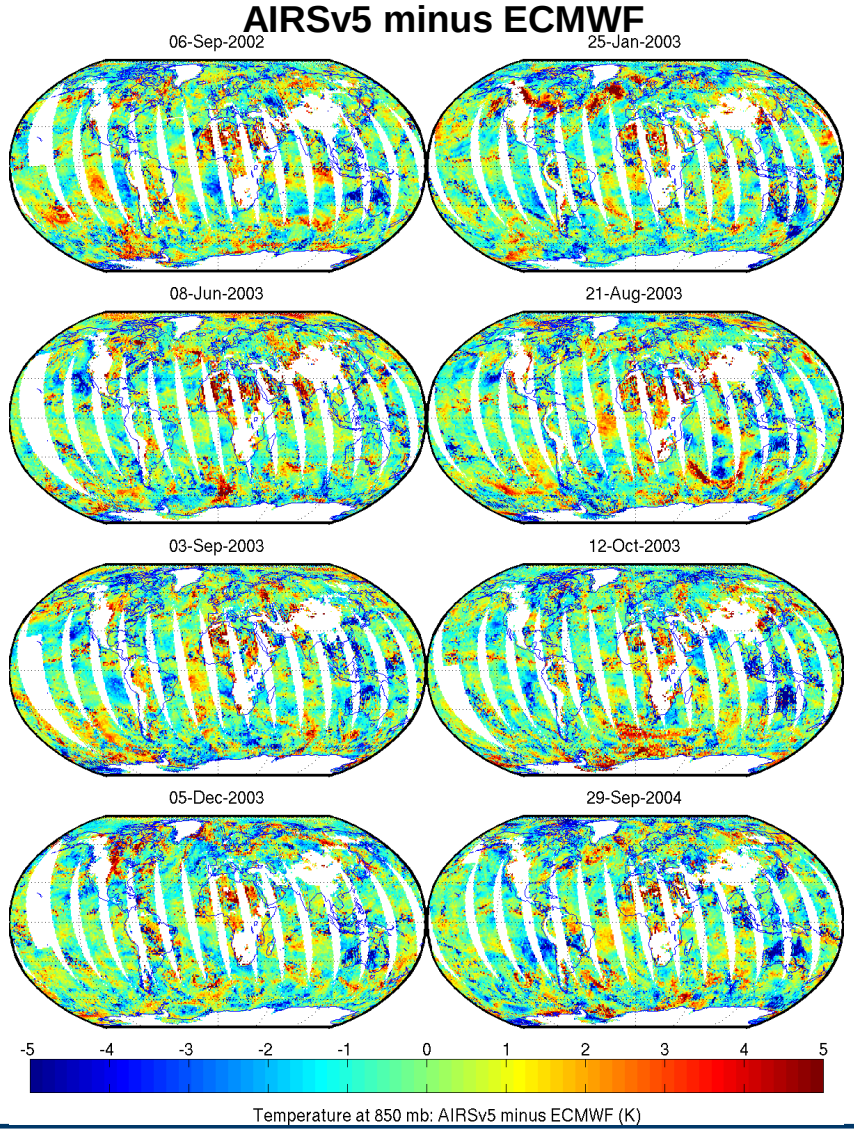


Example Results: Temperature at 500 mb Minus ECMWF, Ascending

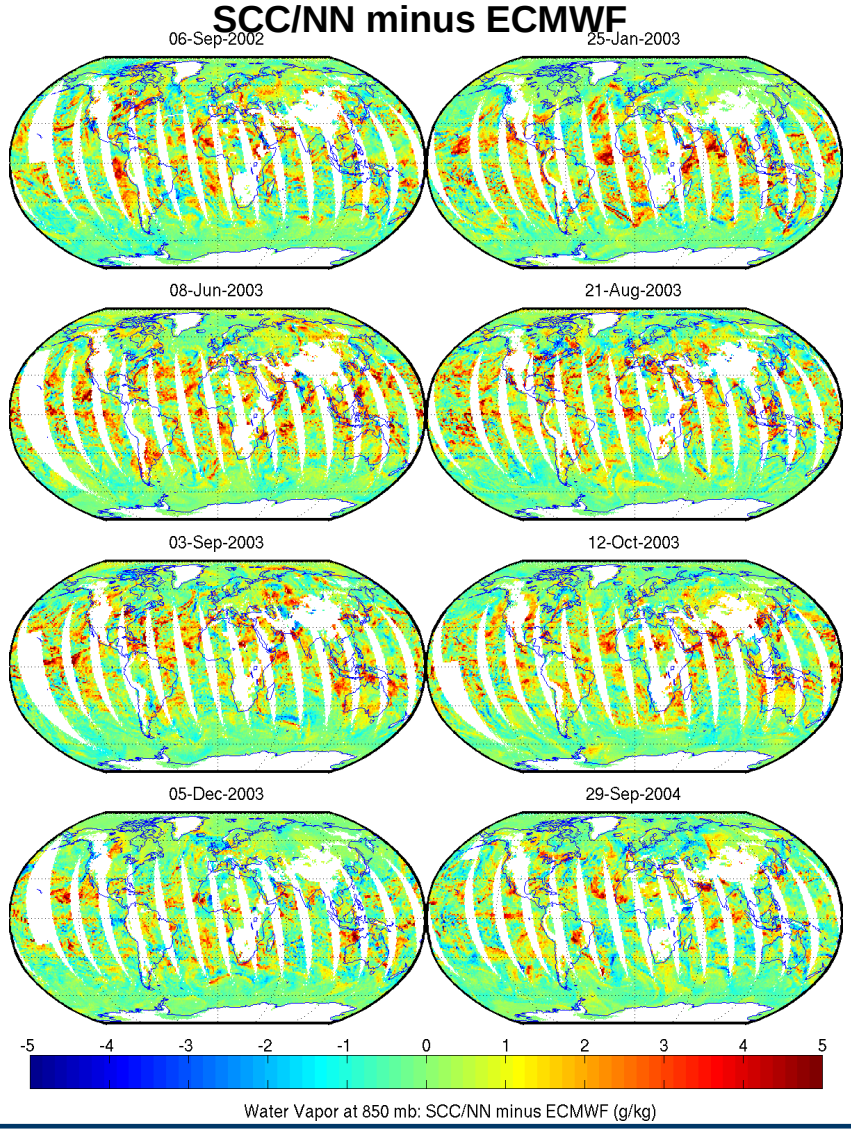


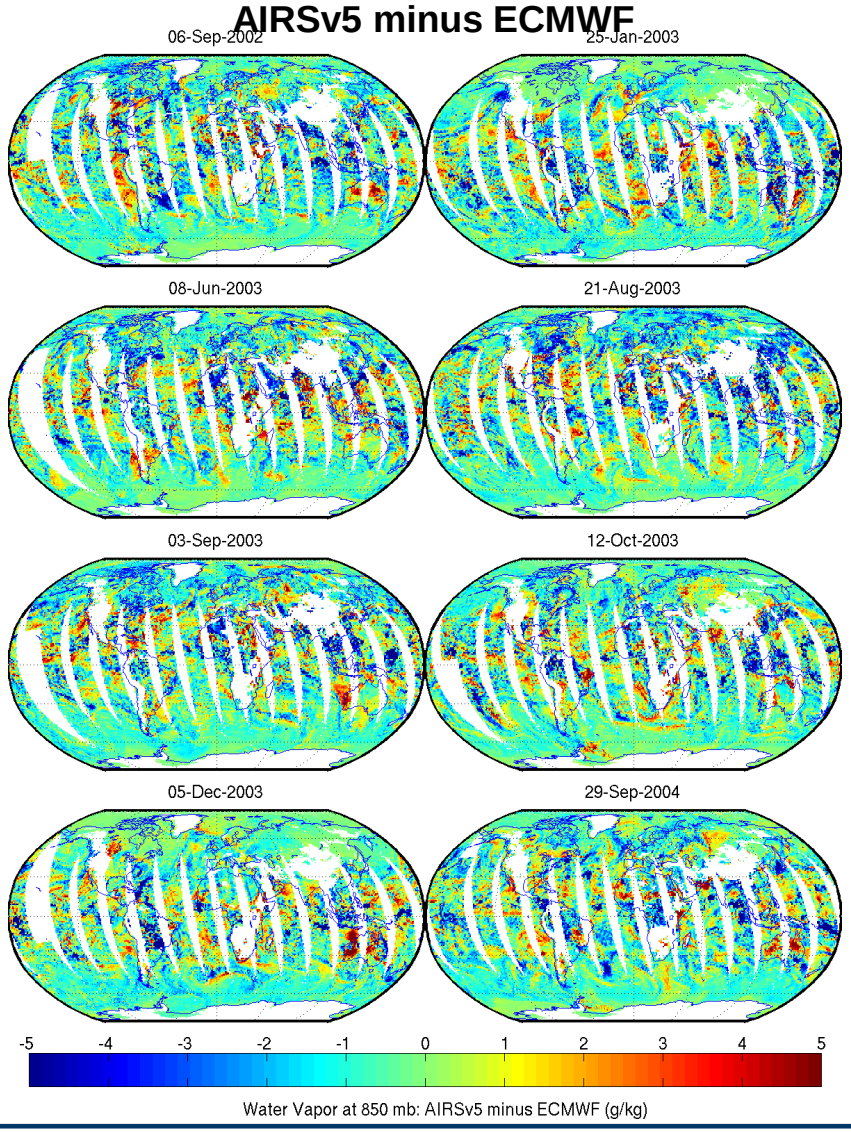
Example Results: Temperature at 850 mb Minus ECMWF, Ascending



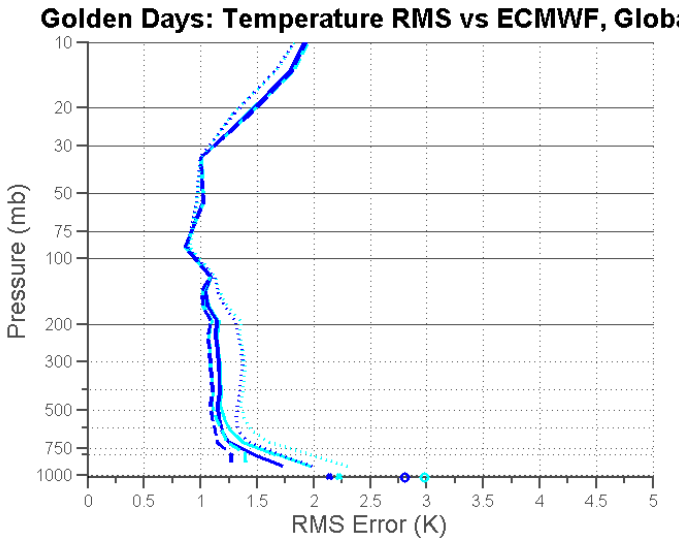


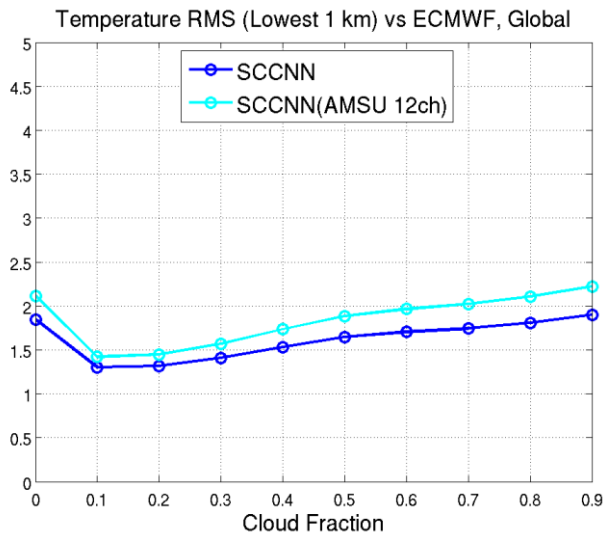
Example Results: Water Vapor at 850 mb Minus ECMWF, Ascending



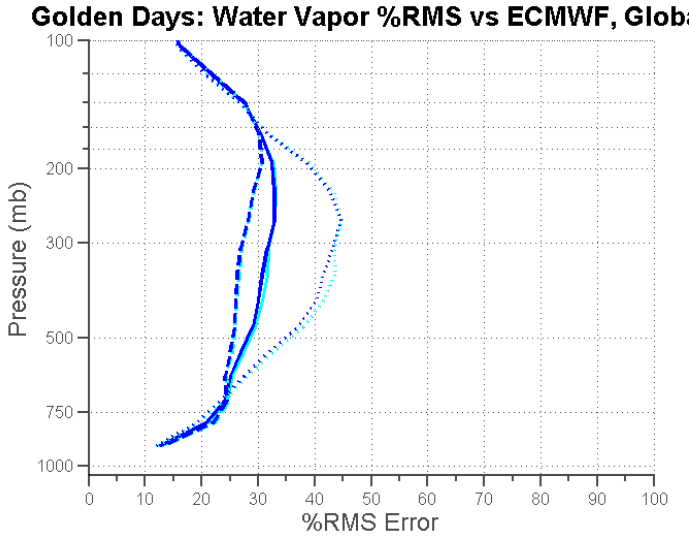


Golden Days: Effect of Excluding AMSU Channels 4, 5, 7 (Post-2007 Approach)



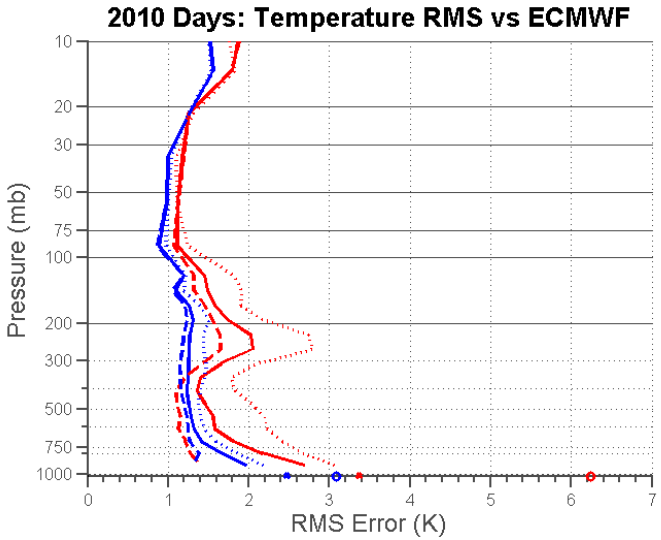


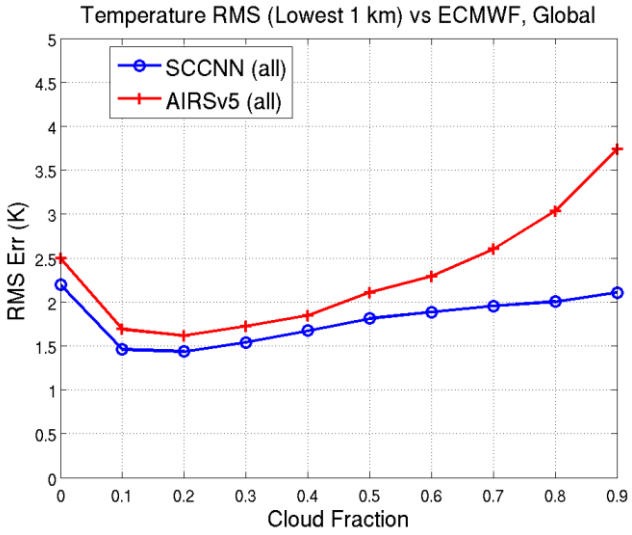
SCCNN (AMSU 12ch, All)
SCCNN (All)
SCCNN (AMSU 12ch, PBest)
SCCNN (PBest)
SCCNN (AMSU 12ch, Not PBest)
SCCNN (Not PBest)

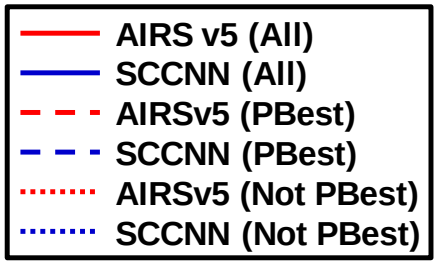


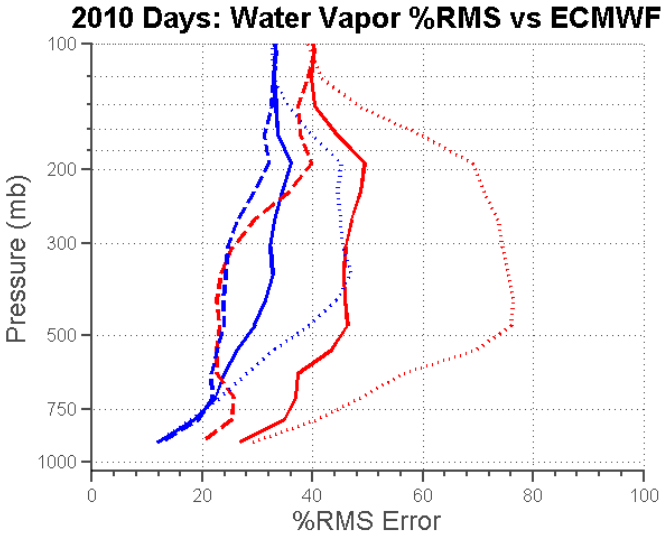
- AMSU channels 4, 5, and 7 not used after 2007 due to noise
  - Different NN used
- Some increase in temperature RMS vs. ECMWF seen near surface

2010: 11 Selected Days, RMS vs. ECMWF









- First day of every month in 2010 when available (11 days total)
- Initial plots with sparser global coverage than Golden Day analysis
  - Planning to update with denser coverage
- Results comparable to Golden Day RMS plots, but slightly greater

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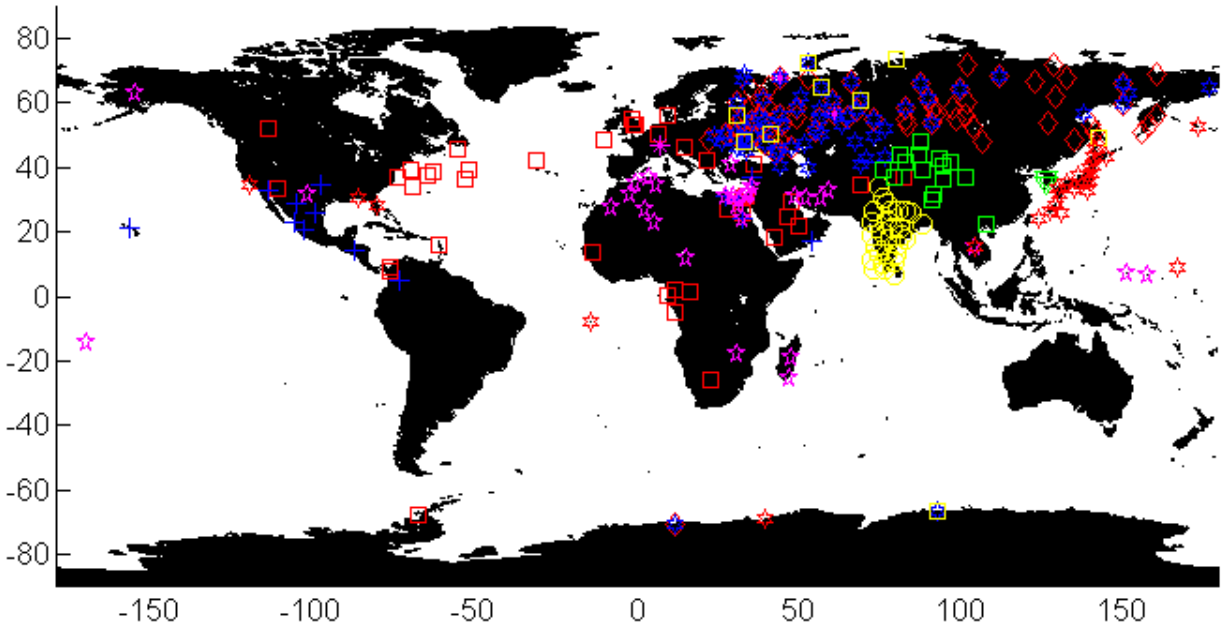
Validation Using Radiosondes

- **Extensive RAOB reports for 2003, 2004, and 2010 provided by Tony Reale and Frank Tilley**
- **We extract interpolated temperature and water vapor profiles from the reports and collocate them to year-round SCC/NN retrievals and ECMWF datasets**
  - **RAOBs collocated to SCC/NN within ± 3 hr. time and 100km**

Number of Collocated RAOB Datasets

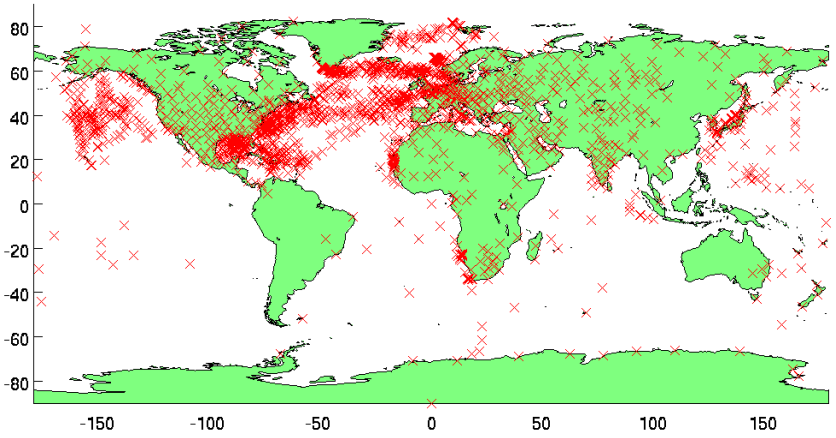
Year	Day	Night	Total
2003	64,568	104,745	168,196
2004	56,486	90,273	145,692
2010	32,388	59,744	91,836
Total	**153,442**	**254,762**	**405,724**

AIRS/RAOB Collocation Sites: 2003

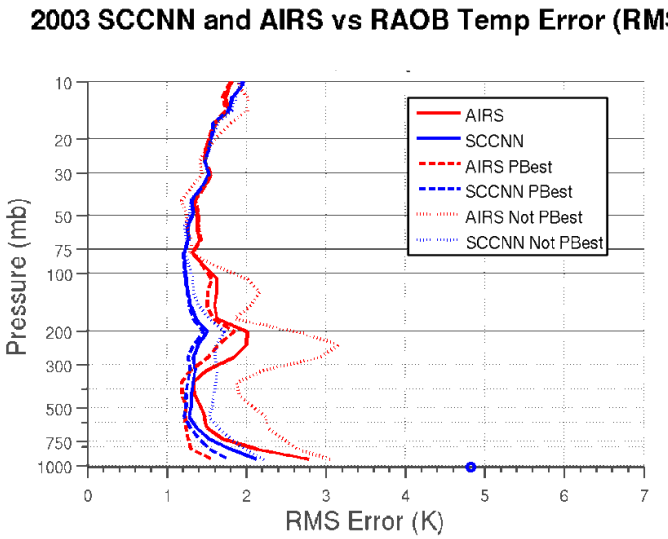


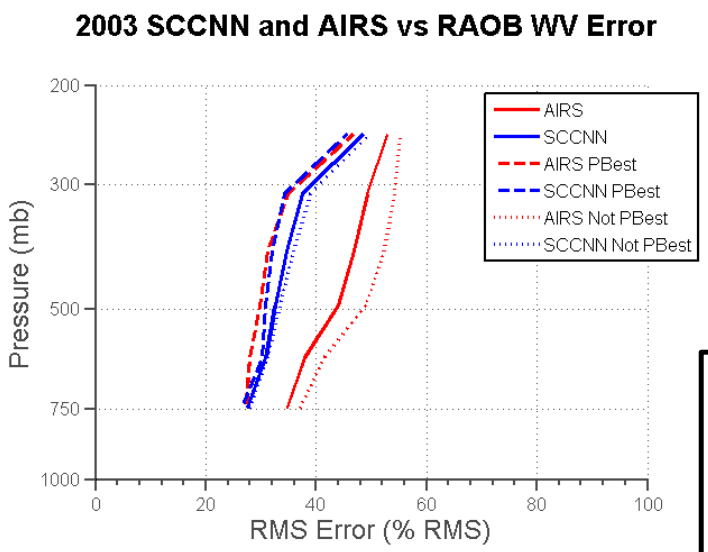
2003 AIRS/RAOB collocation sites, >200 matchups

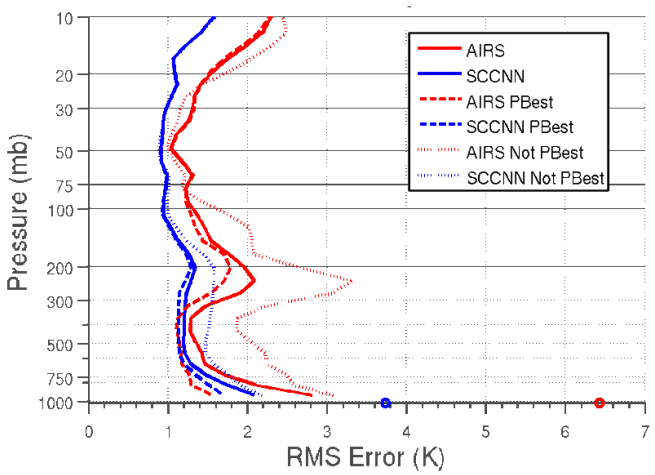
2003 AIRS/RAOB collocation sites, All

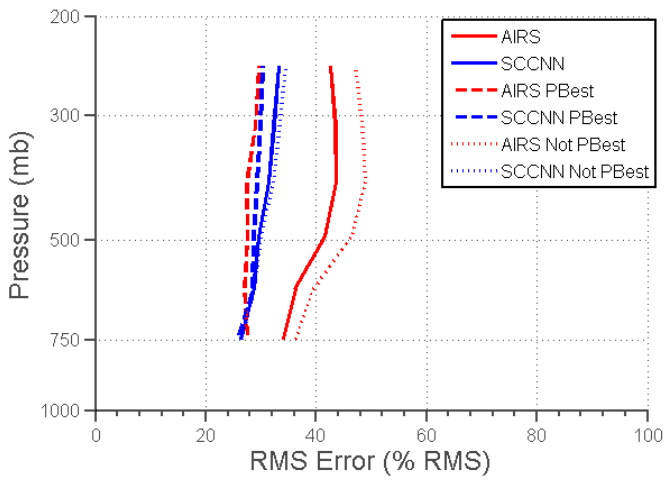


2003: SCC/NN RMS vs. Collocated RAOB and ECMWF





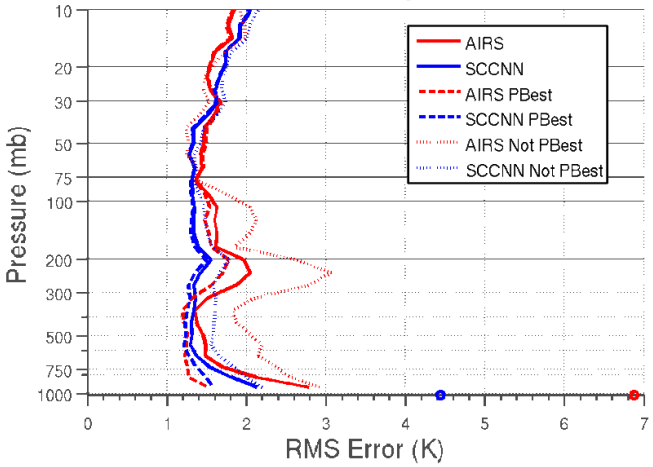




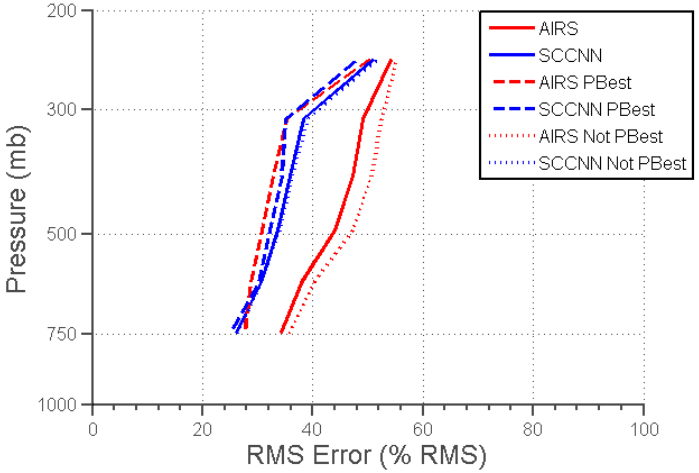
AIRS v5 (All)
SCCNN (All)
AIRSv5 (PBest)
SCCNN (PBest)
AIRSv5 (Not PBest)
SCCNN (Not PBest)

2004: SCC/NN RMS vs. Collocated RAOB and ECMWF

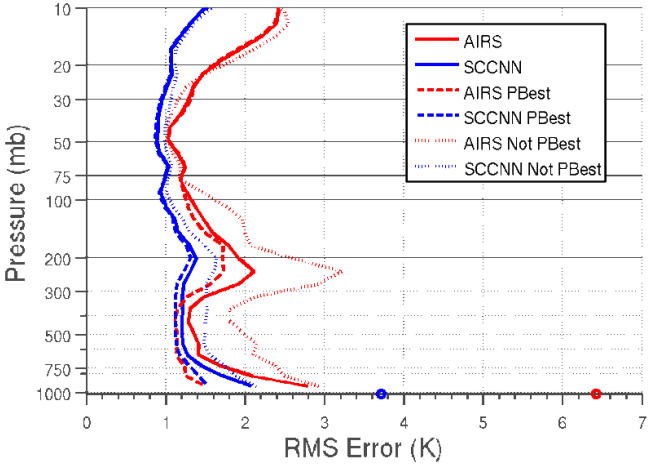
2004 SCCNN and AIRS vs RAOB Temp Error (RMS)



2004 SCCNN and AIRS vs RAOB WV Error



2004 SCCNN and AIRS vs ECMWF Temp Error (RMS)



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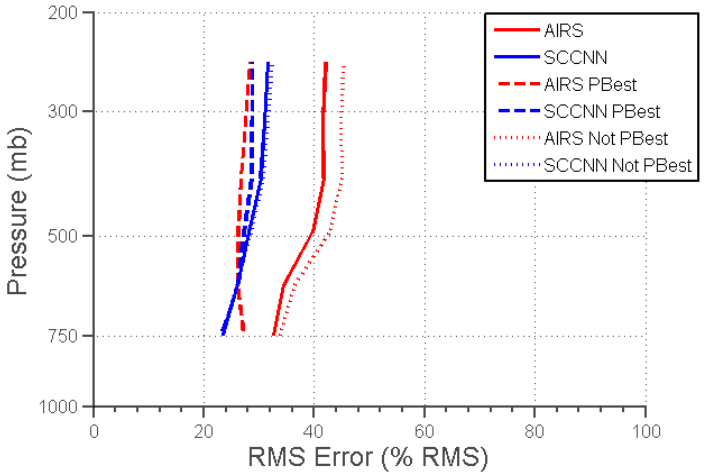
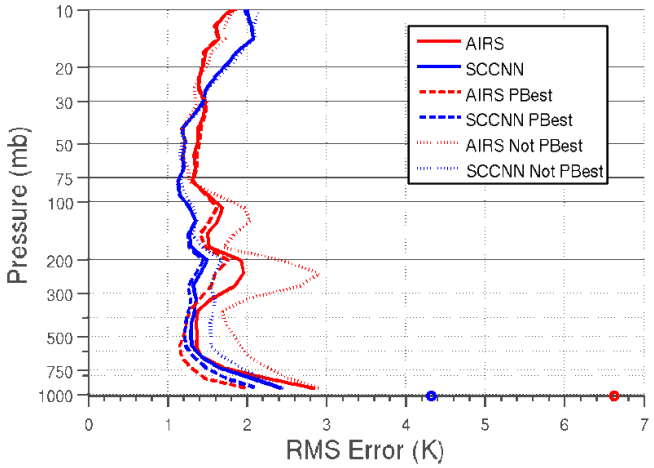


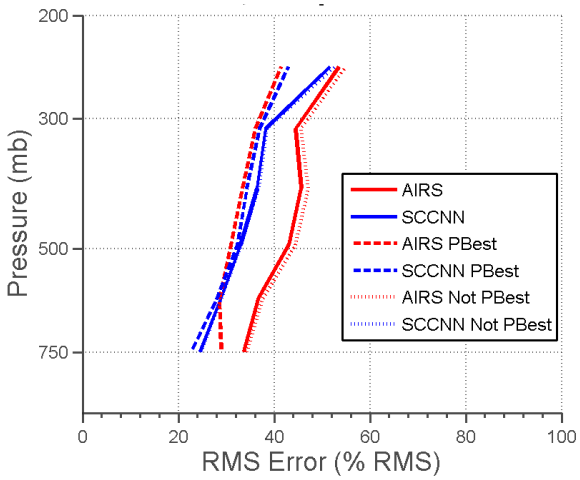
AIRS v5 (All)
SCCNN (All)
AIRSv5 (PBest)
SCCNN (PBest)
AIRSv5 (Not PBest)
SCCNN (Not PBest)

2010: SCC/NN RMS vs. Collocated RAOB and ECMWF

2010 SCCNN and AIRS vs RAOB Temp Error (RMS)



2010 SCCNN and AIRS vs RAOB WV Error



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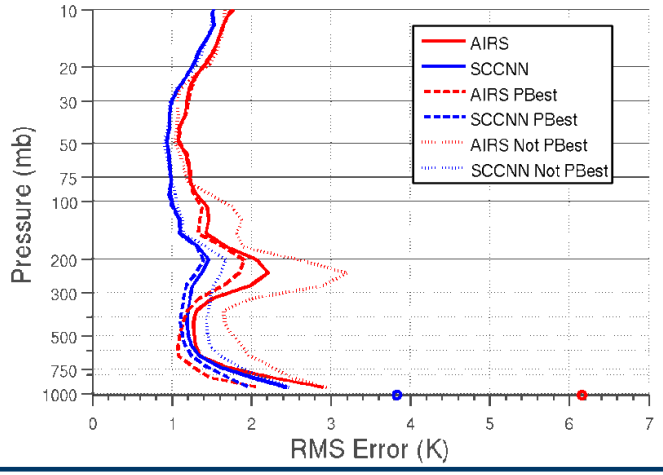
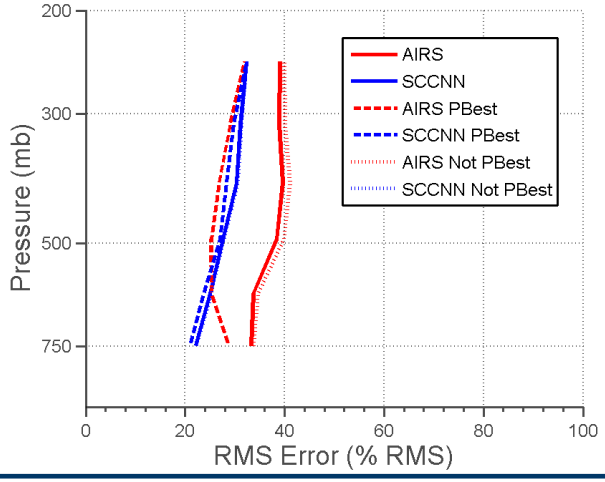
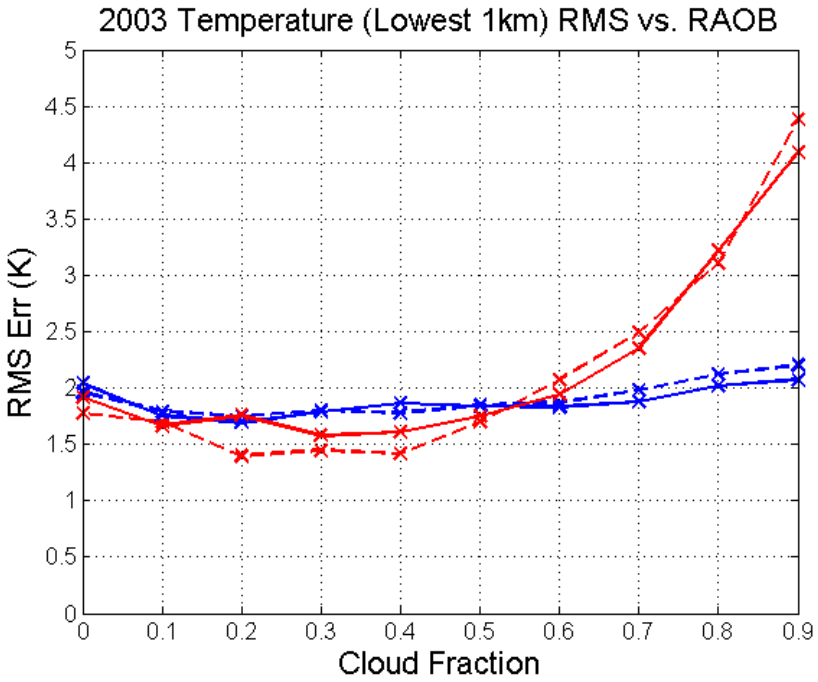


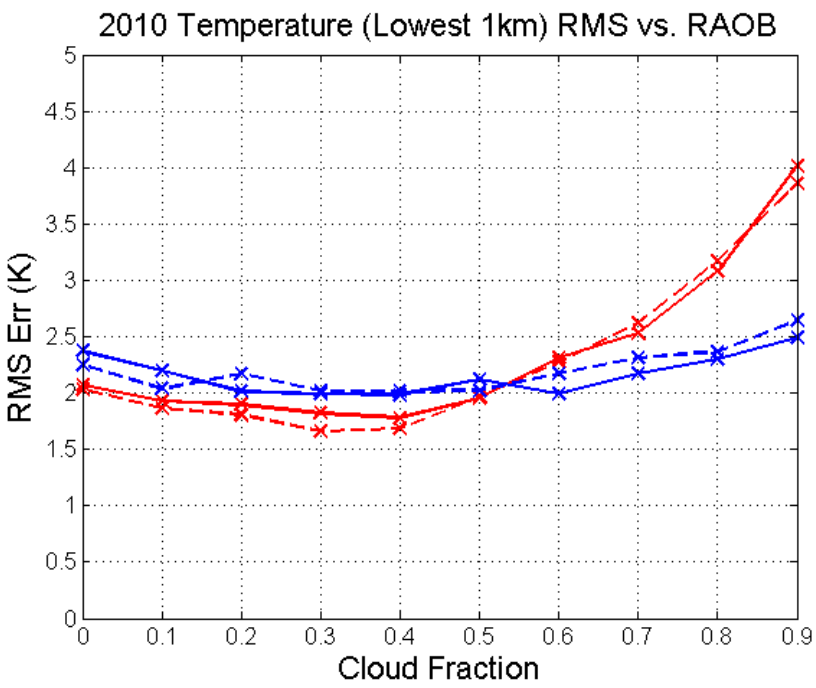
2010 SCCNN and AIRS vs ECMWF WV Error



AIRS v5 (All)
SCCNN (All)
AIRSv5 (PBest)
SCCNN (PBest)
AIRSv5 (Not PBest)
SCCNN (Not PBest)

Temperature RMS Comparison to RAOB in Lowest 1 km versus Cloud Fraction





AIRS v5 (All, Day)
SCCNN (All, Day)
AIRSv5 (All, Night)
SCCNN (All, Night)

- **2010 results show slight RMS increase compared with 2003**
  - **May be attributable in part to use of 12 AMSU channels post-2007**
- **Consistent with ECMWF comparison results over land**

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Conclusions

- **SCC/NN has been comprehensively validated with multiple data sets**
- **Results demonstrate improved retrieval performance, robustness to increased cloud fraction, and consistency over time**
- **Areas of further improvement under investigation**
  - **Repeat of 2010 with improved geographic coverage planned**